There are four main methods of achieving enhanced brightness and/or contrast. These are:

1) to produce more light output from the phosphor per unit area for a given beam current.

2) to provide complimentary lighting, or a low ambient background.

3) to increase the rate of scan by some form of scan- conversion.

4) to cause sustanied flooding of light from each information point on the display, as with a direct view storage tube.

In the United States, the emphasis has been on scan-conversion, and a program of installation and incorporation into comp'ex data handling systems is in full swing under the sponsorship of F.A.A.

Unfortunately it is very difficult to link scan-conversion with digital data handling and alpha-numeric character writing.

When one considers that what is really required is a brighter version of a normal fluoride display, the direct view storage tube (D.V.S.T.) appears more attractive.

The Direct View Storage Tube.

The direct view storage tube is so called because both the storage element and viewing surface are within the one envelope. It also contains two electron guns, a flood gun, and a writing gun.

The short persistance high efficiency phosphor viewing screen is on the inside of the tube faceplate as in a conventional c.r.t. Just behind this is a target which is nearly the same diameter as the faceplate. The target consist of an extremely fine metal mesh with a high insulation material deposited upon the side nearest the flood gun.

It is the capacity between the front surface of the insulating material and target mesh which provides the storage. Brightness is achieved by continually flooding electrons through the storage mesh areas where radar information has been written. The flood gun electrons are collimated by electrodes to arrive normal to the screen, and to uniformly illuminate the whole mesh. The tube electrode potentials are such that the flood gun electrons strike the storage mesh at a speed at which the secondary emission ratio for the insulator is less than unity. The mesh surface then becomes negatively charged to near flood gun cathode potential, and the flood electrons can then penetrate the mesh and uniformly illuminate the screen.

If a negative potential is now applied externally to the mesh, the flood electrons are repelled and collected by a collector mesh, leaving the storage insulator primed, for writing upon. The high velocity electrons from the writing gun are focussed to a fine spot, and can be modulated and deflected, as in a conventional c.r.t. On striking the mesh, secondary emission electrons are released. As the beam moves about the mesh, a positively charged « trace » is drawn upon it, and flood electrons can now penetrate, are accelerated, and reproduce the pattern onto the phosphor.

The duration of the stored image is limited by the presence of positive ions produced in the tube. These ions gradually neutralise the negatively charged mesh, and allow the background to brighten up. However, a train of positive pulses applied to the target can be arranged to hold down this background and to provide a storage time of about 15 mins, far longer than required for a conventional radar display.

Within this time, the stored image can be completely erased by applying a few volts positive to the target, for about one second. Gradual erasure can be achieved by applying pulses to the target, the rate of erasure being controlled by the pulse width and frequency.

The ability to instantaneously erase is useful on displays requiring off-set or expanded radar patterns, as the redundant pattern can be completely and rapidly removed before the new pattern is written.

The three main features of the D.V.S.T. are that:

1) the brightness of the viewed image is obtained by continually flooding the high efficiency phosphor through the stencilled trace upon the storage mesh,

2) the storage mesh provides the « afterglow » by virtue of its controllable transparency,

3) the facility of rapid erase is available.

A 5" version of this tube, in a suitable unit, has been under evaluation in the control towers of Gatwick and London Airport as an approach radar aid. The display shows the last 10 miles of the approache to touchdown, and incorporates switched off-centring to enable both directions of landing to be covered. These are shown in figures 3 and 4.

Fig. 3

More recently, an experimental 11" D.V.S.T. the E712 has been made by the English Electric Valve Company. It is probable that the developed version of this tube will have a light output of around 1000 foot lamberts, and a resolution of 700 lines per diameter, and although the initial cost will be nigh, the life and usefulness should outweigh this for many appli-